

## Fimicolous myxomycetes

Uno Eliasson and Nils Lundqvist

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Thirty-four species of fimicolous myxomycetes are reported, the vast majority from moist chamber cultures. *Physarum spinisporum* U. Eliass. & Lundq., sp. nov., is described. A further nine species are reported for the first time as fimicolous: *Perichaena syncarpon*, *Arcyria incarnata*, *Stemonitis pallida*, *Macbrideola cornea*, *Leocarpus fragilis*, *Physarum nutans*, *P.* cf. *ovisporum*, *Didymium anellus* and *D. verrucosporum*. *Physarum apiculosporum* and *Badhamia semiannulata* are regarded as conspecific and the new combination *Badhamia apiculospora* (Härk.) U. Eliass. & Lundq. is proposed. Previous literature records of fimicolous myxomycetes are listed. Some 80 species in 23 genera have been recorded on dung. Common coprophilous species are *Perichaena* cf. *liceoides*, *Arcyria cinerea*, *Stemonitis fusca*, *Badhamia apiculospora*, *Didymium difforme*, and *D. squamulosum*. The exclusively or preponderatingly coprophilous species are few, constituting less than 2% of the known species. Among these are *Licea alexopouli*, *L. fimicola*, *Perichaena* cf. *liceoides*, and *Calonema luteolum*. Regarding the type of dung, substrate preferences can be traced in some species. Thus e.g. *Perichaena* cf. *liceoides* seems to prefer dung from domestic animals, while *Stemonitis fusca* has only been found on dung from forest animals. The majority of the fimicolous myxomycetes are presumed to be secondary inhabitants on dung. No obvious adaptations to endocoprophily have been found.

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While the myxomycete flora on decaying wood or bark can be regarded as relatively well-known, few comprehensive studies have been made on that on other kinds of substrate. Thus, surveys of the coprophilous myxomycete flora are lacking, even though some authors, e.g. Jahn (1916), Hertel (1962), and Keller & Anderson (1978), have shown an interest in the coprophily of these organisms. The majority of the literature records are fairly recent and none is known to us from the 18th century, the oldest being Schumacher's (1803) report of *Physarum fimetarium*, a dubious name, the explanations may be that the interest in coprophilous fungi did not boom until the 1860's, and that the moist chamber method did not come into common use

until 40 years later (Lundqvist 1972 pp. 41, 43).

The aim of the present paper is to give a general idea about which species may occur on dung and whether certain taxa could be regarded as predominantly or exclusively coprophilous. We report finds on dung for 34 species. Nine of these have not previously been reported from this substrate, while one species is described as new. We also summarize available records from the literature. Since several specimens were found to deviate from the normal range of variation and since so many problems are unsolved regarding the delimitation of several myxomycete taxa, it proved necessary to include short descriptions and taxonomic comments and discussions in some cases.

### Material and methods

The new finds represent over 160 samples; the majority were taken by Lundqvist during 1959–1978 using the moist chamber technique described in Lundqvist (1972 p. 12). Eliasson is responsible for the identification of the material and for the descriptions and taxonomic comments. Most literature records are excerpts from an index of coprophilous fungi started by Lundqvist and continuously kept up to date. Lundqvist is responsible for all historical records included and has compiled the section on 'Additional species reported from dung'. Unless otherwise stated the photos have been taken by Eliasson.

All collections studied are represented in UPS; incomplete series are in GB and in N. E. Nannenga-Bremekamp's private herbarium in Doorwerth, the Netherlands (N-B). Unless otherwise stated the collections originate from moist chamber cultures.

### Development in cultures

The specimens in our cultures always developed late, usually after 3 weeks or more, when the dung and the underlying filter paper had become considerably decomposed. This behaviour is common among myxomycetes, as they feed on bacteria and other microorganisms, which abound in decaying substrates. Large, spreading plasmodia could often be seen on the dung or the filter paper if the moisture was optimum. Too high a moisture, however, hampers the development of fruit-bodies and normal spores. One month or more is probably a normal period of time for a life-cycle (cf. Mock & Kowalski 1976, Mulleavy 1977, Faurel & Schotter 1965 b, c, 1966).

We consider that the moist chamber culture method is efficient on the whole and that the majority of species present actually fructificate under these conditions, a conclusion also reached by Keller (1971) for the genus *Perichaena*. Some myxomycete species, however, do not appear in moist chamber cultures (Gray & Alexopoulos 1968), also a phenomenon known for the coprophilous species of true fungi.

### Substrate preferences

In our material, cow dung is the most favoured substrate (55 myx. coll.), followed by dung from hares (5 species) 23, horse 21, rabbit 18, elk and moose 14, roe deer 7, goat 5, sheep 5, capercaillie 3, donkey 3, camel 2, lemming 2, grouse 2, buffalo, deer, dik-dik, duiker, eland, omnivore,

black grouse, and caterpillar, a total of 25 animal species. Although this distribution primarily reflects that some substrates are more frequently collected than others, substrate preferences can be traced for some myxomycete species. About 80% of all our finds of *Perichaena* cf. *liceoides* are on cow dung, and this species seems to prefer the dung from domestic animals (cow, horse, donkey, sheep; 32 samples). *Didymium difforme* has also often been recorded on cow dung (38%) but has a wider range (9 "host" species). *Arcyria cinerea* is not uncommon on horse dung (50%, 6 "hosts"). *Stemonitis fusca* has only been collected on dung from forest animals (elk, roe deer, hare; 10 finds), a phenomenon known in some coprophilous species of true fungi as well (Lundqvist 1972 pp. 21–27). When the published finds of the species mentioned here are also taken into account, their habitat range appears somewhat broadened, but their substrate preference not necessarily so. *Perichaena chrysosperma*, however, which in our material is mainly found on dung from lagomorphs, does not show any distinct substrate preference when other published records are included. No distinct trends can be recognized where the common coprophilous species *Badhamia apiculospora* and *Didymium squamulosum* are concerned. To obtain a complete picture of the ecological demands of fimicolous myxomycetes, naturally finds on substrates other than dung must also be taken into consideration, but that is beyond the theme of this paper.

A total of over 80 species in 23 genera of myxomycetes have been recorded on dung, viz. c. 15% of the currently accepted species. However, only a limited number can be regarded as common on this substrate. The seven species mentioned in the preceding paragraph belong here. In fact, most myxomycetes found on dung are more frequently recorded on other substrates. Very few seem to be exclusively or preponderantly coprophilous. Good examples are *Licea alexopouli*, *L. fimicola*, *Calonema luteolum*, and *Badhamia apiculospora* ('*B. ovispora*'). This category constitutes less than 2% of the total number of species.

Some species which have been described on samples from dung (field samples or moist chamber collections) are, so far, known only from one or two collections. Naturally in these

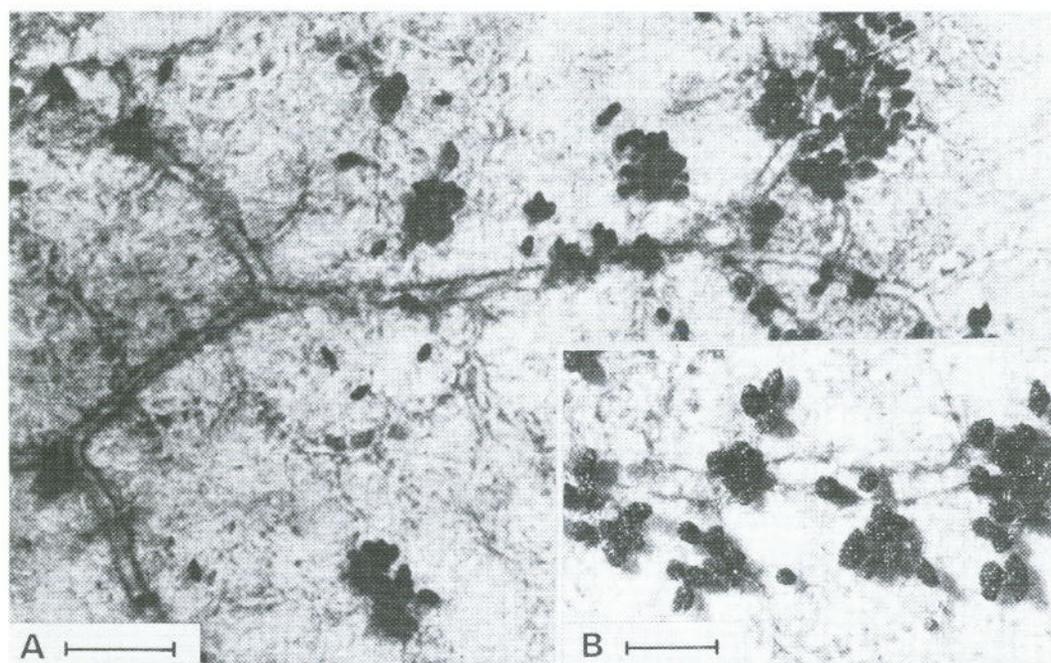


Fig. 1. *Licea fimicola*, sporangia on filter paper in moist chamber culture on dung (Ahti 26567-d). – A: Sporangia and tracks of the phaneroplasmodial veins. – B: Portion of A further enlarged. – Scales: A 1 mm, B 0.5 mm.

cases it is impossible to state whether or not they might be preponderatingly coprophilous. *Arcyria elaterensis*, *Trichia fimicola*, *Macbrideola coprophila*, *Squamuloderma nullifila*, and *Didymium rugulosporum* belong to this category. Some fimicolous species have been grown on artificial media. Among these are *Licea alexopouli* (Mock & Kowalski 1976), *L. fimicola* (Keller & Anderson 1978), *Arcyria elaterensis* (Mulleavy 1977), and *Squamuloderma nullifila* (Kowalski 1973).

#### Spore dispersal

The question of ecological specialization in the coprophilous myxomycetes brings up the problem of their spore dispersal. Are there any true endocoprophilous species among them or do they only inhabit the dung secondarily? We are not aware of any investigations on the subject, and the very few students who have examined the fungus flora of gut and stomach contents taken from butchered animals and placed in

sterilized moist chambers have not reported myxomycetes in their material (Masse & Salmon 1902, Schmidt 1913, Larsen 1971). We presume that the majority of the fimicolous myxomycetes are only secondary inhabitants on dung. Their spores are dispersed by wind or insects, generally epizoochorously. Non-stipitate species without a capillitium, such as *Liceae*, are not adapted to wind-dispersal, and some of them seem to be strictly coprophilous. If they are endocoprophilous, their spores would be expected to show adaptations for dispersal to the surrounding vegetation to be eaten and spread by the vectors, but such adaptations are not known.

Keller & Smith (1978) found that the spores of an undescribed species of *Didymium* were eaten by the acarid mite *Tyrophagus putrescentiae* (Shank). The spores were observed passing through the digestive tract of the mite. When fragments of fecal pellets were suspended in sterile water as hanging drop cultures, intact spores were found to be viable and germinate.

**List of animals referred to**

Artiodactyls: Barbary sheep (*Ammotragus lervia*), "biche harnachée" (probably bush buck, *Tragelaphus scriptus*), bison (*Bison bison*), buffalo (*Syncerus caffer*), deer (indet.), dik-dik (*Rhynchotragus*), duiker (*Cephalopus*), eland (*Taurotragus oryx*), elk (*Alces alces*), fallow deer (*Dama dama*), gazelle (in N Africa probably *Gazella dorcas*), moose (*Alces alces gigas*), nilgai (*Boselaphus tragocamelus*), pronghorn (*Antilocapra americana*), red deer (*Cervus elaphus*), roan antelope (*Hippotragus equinus*), roe deer (*Capreolus capreolus*).

Hyracoids: Dassie (in N Africa *Procavia antineae*, in Tanzania *Procavia*, *Heterohyrax* or *Dendrohyrax*).

Rodents: "Goundi" (*Massoutiera harterti*), lemming (*Lemmus lemmus*), mouse (indet.), porcupine (*Erethizon dorsatum*), "sand rat" (*Psammomys algiricus*).

Lagomorphs: Hare (indet. *Lepus*), black-naped hare (*Lepus nigricollis*), blue hare (*L. timidus*), Cape hare (*L. capensis*), European hare (*L. europaeus*), Kabylian hare (*L. kabylicus*), rabbit (in Europe, N Africa and the Canary Islands *Oryctolagus cuniculus*, in North America *Lepus* and *Sylvilagus*).

Bats: Flying fox (*Pteropus medium*).

Marsupials: Kangaroo (indet.).

Birds: Bird (indet.), bird of prey (indet.), black grouse (*Lyrurus tetrix*), capercaillie (*Tetrao urogallus*), goose (*Anser?*), grouse (*Lagopus*), rock dove (*Columba livia*).

Insects: Caterpillar (*Hyponomeuta*).

Domestic herbivores mentioned are cow, yak, horse, donkey, mule, goat, sheep, camel, reindeer, Indian elephant.

**Abbreviations**

EXS ined. = an unissued exsiccata of fimicolous fungi.

Lqt Lundqvist, S Santesson.

Abbreviations of herbaria follow Holmgren & Keuken (1974).

Swedish provinces: *Sk* Skåne, *Bl* Blekinge, *Öl* Öland, *Gtl* Gotland, *Ög* Östergötland, *Vg* Västergötland, *Hl* Halland, *Bh* Bohuslän, *Srm* Södermanland, *Upl* Uppland, *Vsm* Västmanland, *Dlr* Dalarna, *Gstr* Gästrikland, *Hls* Hälsingland, *Ång* Ångermanland, *Hrj* Härjedalen.

The provinces are cited roughly from south to north. The smallest locality unit listed is usually a parish or similar area. Extra-Swedish localities are mostly given more accurately.

***Licea alexopouli* Blackw. – Fig. 2 A**

Kenya: *Rift Valley*, Nakuru, 10 km E of Londiani (cow) Lqt 6514-g – Tanzania: *Arusha*, Mt Meru (buffalo) Lqt 6480-k; SW of Oldonyo Sambu (cow) Lqt 6511-h (GB, N-B) – USA: *California*, Los Angeles Co., Santa Catalina Isl. (cow) S 17297-u (GB, N-B) – New to the Old World.

*Literature records*: USA: (bison, cow, horse) Blackwell 1974, Mock & Kowalski 1976, Keller & Anderson 1978.

***Licea cf. belmontiana* Nann.-Brem.**

Sweden: *Bh*, Marstrand (hare) Nordin 4547-c – Norway: *Finnmark*, Nord-Varanger par., Fossefjellet (blue hare) Lqt 4965-h – Spain: *Canary Islands*, Tenerife, Anaga Peninsula, San Andrés (rabbit) S 19304-k (GB).

Sporangia gregarious or scattered, hemispheric, 0.05–0.15 mm in diam., olivaceous brown, slightly shiny; peridium yellowish brown in transmitted light, with some refuse matter included, peridial platelets obscure; spores olivaceous brown in transmitted light, dark brown in mass, 10.5–11  $\mu$ m in diam., smooth or almost smooth, with a thinner and paler area on one side.

The spores are slightly smaller than hitherto described for *L. belmontiana* (Nannenga-Bremekamp 1966, 1974), but the material is closer to this species than to other taxa so far recognized in the genus.

***Licea fimicola* Dearn. & Bisby – Fig. 1**

Mongolia: *Central Aymag*, 145 km W of Ulan Bator (cow or yak) Ahti 26567-d – Kenya: *Mandera*, S of Banissa (dik-dik) Thulin 2686-g – New to the Old World.

*Literature records*: Canada: (horse) Bisby et al. 1929 – USA: (cow, pronghorn) Angel & Wicklow 1975, Keller & Anderson 1978.

So far this species has only been found on dung. Although rarely collected in the field (Martin & Alexopoulos 1969), it has been found several times in moist chamber cultures (Keller & Anderson 1978). The species may well be more common than the field collections would suggest, as the sporangia, because of their peculiar appearance (Fig. 1), can be mistaken for droppings of insects or insect larvae.

Keller & Anderson (1978) pointed out that *L. fimicola* has a phaneroplasmodium, a condition that is also apparent from Fig. 1, where tracks of the plasmodial veins are visible on the substrate. This is of interest as species of *Licea* normally have protoplasmodia and the plasmodium type is considered to be of taxonomic importance. The other two known exceptions of a protoplasmodium in *Licea* are *L. retiformis* Nawavi

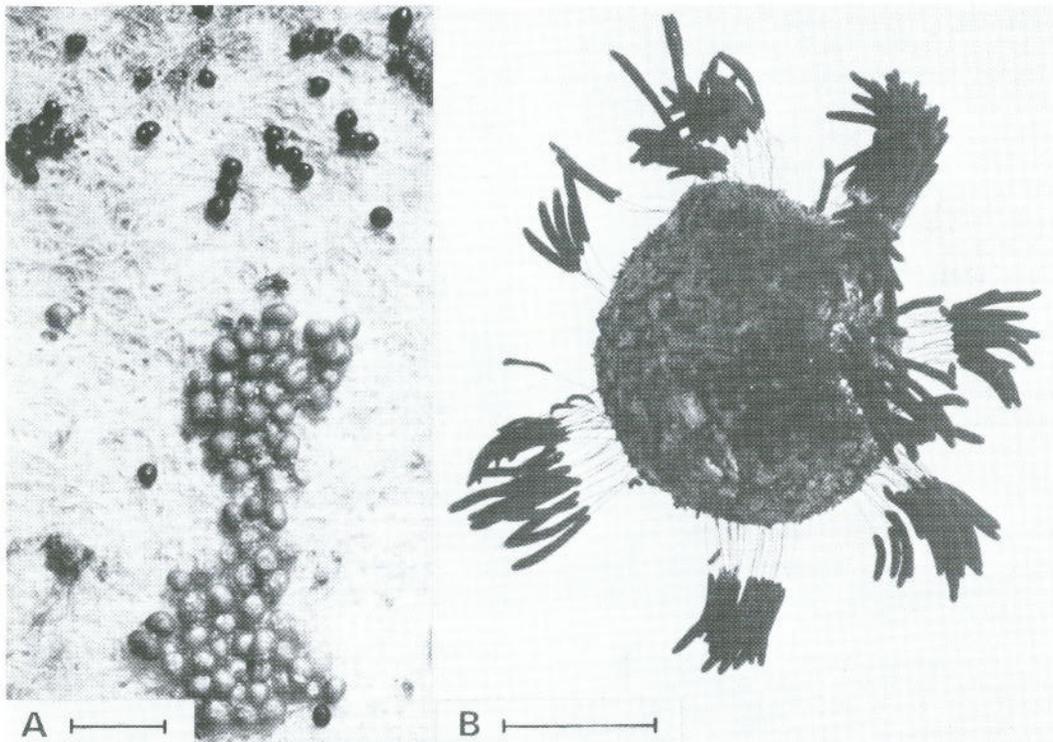


Fig. 2. A: *Licea alexopouli* (shining black sporangia) and *Perichaena* cf. *liceoides* on filter paper in moist chamber culture on dung (Lqt 6511-g). – B: *Stemonitis fusca*, sporangia on dropping of hare, moist chamber culture (Lqt 5906-g). – Scales: A 0.5 mm, B 5 mm.

and *L. variabilis* Schrad., both of which possess a plasmodium of the trichiaceous kind. In these two species there is probably a relationship with *Perichaena* (Alexopoulos 1976, Eliasson 1977), but in the case of *L. fimicola* the affinity is clearly far from this.

#### *Licea pusilla* Schrad.

Sweden: *Upl*, Söderby-Karl par., Brölunda (horse) Lqt 2514-b.

*Literature record*: Norway: (mouse) Moravec 1968.

#### *Perichaena chrysosperma* (Currey) A. Lister

Sweden: *Gil*, Gotska Sandön Isl. (hare) Tibell 2195-p, 2196-s; Östergarn (rabbit) Lqt 2110-p. *Hrj*, Storsjö par., Mt Helagsfjället, 1400 m (lemming) K. & L. Holm 21.VIII.1967 (slide) – Spain: *Canary Islands*, Tenerife, Anaga Peninsula, San Andrés (rabbit) S 19304-q (GB, N-B) – USA: *California*, Los Angeles Co., Santa

Catalina Isl. (cow) S 17297-f (GB, N-B) – Ecuador: *Los Ríos*, Salinas (donkey) Martin 3.IX.1945 (GB).

*Literature records*: Poland: (red deer) Schmidt 1912 (as *Cornuvia circumscissa* var. *spinosa*) – Hungary: (cow) Tóth 1963; (deer) Tóth 1965 (as *Ophiotheca* c.) – Sri Lanka (elephant) Lister 1925 – Tanzania: (mule) Schmidt 1913.

In the material studied the fructifications are sporangia or short plasmodiocarps, never elongated or reticulate plasmodiocarps as often seen in *P. vermicularis* (Schw.) Rost. The spores are generally 8.5–10  $\mu\text{m}$ , and in some fructifications up to 11  $\mu\text{m}$ . The papillose inner peridium was considered by Keller (1971) to be a characteristic feature in *P. vermicularis*. In the specimens cited the inner peridium is faintly papillose in some sporangia, smooth in others. The distinction is not clear and the ornamentation is so faint in some cases that the peridium could be regarded as almost smooth. The capillitium is generally conspicuously spiny, but there are great differ-

ences even between adjacent fructifications or between capillitial parts within one fructification. In duplicate specimens of S 19304-q a large part of the capillitium is completely spineless, while some capillitial parts within the same fructification have conspicuous spines. One of the collections studied (Lqt 2110-p) has (at least in the two sporangia investigated) large spores, 12–13.5  $\mu\text{m}$  in diam. This is outside the variation range normally ascribed to *P. chrysosperma*, and the specimen would key to *P. vermicularis* in e.g. Martin & Alexopoulos (1969) and Keller (1971). However, it agrees with *P. chrysosperma* in other characteristics, and could probably correctly be accommodated within this taxon.

#### *Perichaena corticalis* (Batsch) Rost.

USA: California, Los Angeles Co., Santa Catalina Isl. (cow) (with *Didymium difforme*) S 17297-k. Colorado, Boulder Co., Mt Steamboat (cow) S 18499-E.

Literature records: Hungary: (hare) Tóth 1963; (cow, deer, goose) Tóth 1965, 1967 – Algeria: (donkey, camel, Barbary sheep) Faurel & Schotter 1965 c – Tchad: (goat, gazelle) Faurel & Schotter 1966 – Congo: (gazelle) Faurel & Schotter 1965 d – Chile: (cow) Spegazzini 1921 (as *P. populina*).

Despite the widely scattered sporangia lacking circumscissile dehiscence, the specimens cited are best included in *P. corticalis*. The spores are c. 12  $\mu\text{m}$  in diam., and the capillitium is devoid of spines. Where fructifications of *P. corticalis* and *P. chrysosperma* occur together the different colour of the spore masses is often striking, that of *P. chrysosperma* generally being a brighter yellow than that of *P. corticalis*.

#### *Perichaena depressa* Libert

Sweden: *Gtl*, Gotska Sandön Isl. (hare) Tibell 2201-z – Tanzania: *Kilimanjaro*, Mt Kilimanjaro, 3500 m (eland) Lqt 6407-f.

Literature records: Hungary (cow, deer, hare) Tóth 1963, 1965, 1967.

#### *Perichaena* cf. *liceoides* Rost. – Figs. 2 A, 3

Sweden: *Bl*, Kristianopel (horse) Lqt 3360-d (EXS ined.) (GB), (cow) Lqt 3364-j (GB, N-B). *Öl*, Råpplinge (horse) Lqt 2301-e, (cow) Lqt 2302-d; Resmo (cow) S 19615-f. *Gtl*, Lilla Karlsö Isl. (sheep) Jacobson

16.V.1970; Östergarn (horse) Lqt 2104-j. *Srm*, Aspö (cow) Lqt 2022-n, 2454-d. *Upl*, Älvkarleby (horse) Lqt 4210-e (GB, N-B). Ärentuna (cow) Lqt 11864-c; Bällinge (cow) Lqt 2804-b (GB); Häverö (horse) Lqt 10223-c; Läby (cow) Lqt 4074-c; Nysätra (cow) Lqt 2009-d. *Vsm*, Svedvi (cow) Lqt 2357 – France: *Bouches-du-Rhône*, le Pèbre (cow) Lqt 9658-b. *Corsica*: *Ajaccio* (cow) Lqt 4409-f. *Belgodere* (cow) Lqt 4485-h. *Bonifacio* (cow) Lqt 4425-m (GB), 4427-e (GB), (donkey) Lqt 4428-e (GB), (cow) Lqt 4435-d. *Porto-Vecchio* (cow) Lqt 4448-d (GB). *Sartène* (cow) Lqt 4423-d – Yugoslavia: *Croatia*, Velebit Mts, near Mandekić (cow) Lqt 7578-f – Mongolia: *Central Aymag*, 145 km W of Ulan Bator (cow or yak) Ahti 26567-e – Sri Lanka: *Matale*, Dambulla (cow) Lqt 9164-n. *Monaragala*, W of Wellawaya (cow) Lqt 11398-f – Tanzania: *Arusha*, SW of Oldonyo Sambu (cow) Lqt 6511-g (GB, N-B) – Madagascar: *Tamatave*, Île S:t Marie, Ampanihy Forest (cow) Jonsson 1033-e (GB) – USA: *California*, Los Angeles Co., Santa Catalina Isl. (cow) S 17297-t. *Colorado*, Boulder Co., Mt Steamboat (cow) S 18499-D (GB).

Literature records: Denmark: (fallow deer) Lister 1925 – Germany: (dung) Jahn 1916 – Morocco (cow, horse) Malençon & Bertault 1968 – USA: (cow) Keller & Anderson 1978.

Sporangia (Figs. 2 A, 3 A) globose, sessile, 0.1–0.2 mm in diam., scattered or gregarious; peridium yellowish brown to darker brown, if yellowish brown, translucent and generally separated from the spore mass, if darker, less translucent (or nontranslucent) and with varying amounts of refuse matter included, inner surface of peridium almost smooth to faintly papillose; capillitium lacking or present, rarely well-developed and of *Perichaena*-type (Fig. 3 B), sometimes consisting of short threads, sometimes appearing as simple outgrowths from the inner surface of the peridium; spore mass yellow, spores 9.5–12  $\mu\text{m}$  in diam., smooth or very faintly warted.

The description given here may appear rather expansive. An aggregate of yellowish brown sporangia (Fig. 2 A) with translucent peridium may seem very different from scattered, dark brown fructifications (Fig. 3 A) with nontranslucent peridium. However, specimens exhibiting the extremes as well as a series of transitional forms do exist (e.g. Lqt 4448-d). The ornamentation of the inner surface of the peridium may be relatively prominent and reminiscent of that figured by Keller & Brooks (1977) for *Licea scyphoides* Brooks & Keller, but may in other sporangia be much fainter and sometimes hardly distinguishable. Also intergradations occur where the amount of capillitium and size of spores are

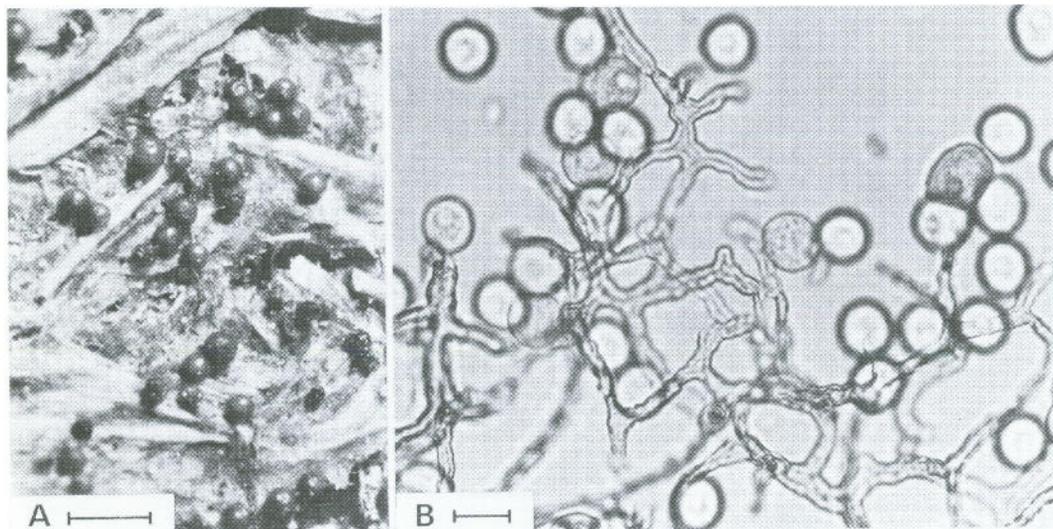


Fig. 3. *Perichaena* cf. *liceoides*, a specimen with well-developed capillitium, moist chamber culture on cow dung (Lqt 7578-f). - A: Sporangia. - B: Capillitium and spores. - Scales: A 0.5 mm, B 10  $\mu$ m.

concerned. Some specimens have spores 9.5–10.5  $\mu$ m in diam., others 11.5–12  $\mu$ m. It has not been possible to correlate e.g. spore size with other characteristics in the same sporangium.

Most of the sporangia studied lack a distinct capillitium and would key to *Licea tenera* Jahn in determination literature (cf. Santesson 1964). However, the spore wall is uniform in thickness and colour, while the spores of *L. tenera* have (ex char.) a thinner and paler area on one side. Moreover, some sporangia have a relatively well-developed capillitium, and there are transition forms to sporangia without a capillitium. For this reason the specimens could hardly be accommodated in *Licea*, at least not as long as the absence of a capillitium is maintained as an important characteristic of this genus. However, the presence or absence of a capillitium as a generic character has been questioned (Alexopoulos 1976, Eliasson 1977).

The specimens studied show a variation, the background and pattern of which can probably only be traced by culture studies. Keller, who kindly examined some of the specimens, wrote (pers. comm.): "Probably the best identification for your specimens with capillitium is *Peri-*

*chaena liceoides*". Considering the transition forms mentioned, all the material is here tentatively referred to this taxon. Kowalski (pers. comm.), who examined a specimen (Lqt 7578-f; Fig. 3) with a well-developed capillitium, regarded it as close to *Calonema luteolum* Kow. although different in colour. However, as the collection seen by Kowalski is connected by transition forms to specimens better identified as *P. cf. liceoides*, it is here cited under this taxon.

Nannenga-Bremekamp (pers. comm.) has pointed out that *Licea tenera* has been misinterpreted in recent literature. The true *L. tenera* differs in some morphological characters to the description given by e.g. Martin & Alexopoulos (1969) and is a species probably restricted to wood or bark.

#### *Perichaena quadrata* Macbr.

USA: Iowa, Iowa City (rabbit) Martin III. 1935.

Most monographers, including Martin & Alexopoulos (1969), have placed *P. quadrata* in synonymy with *P. depressa*, but Keller (1971, 1973) claims that they are autonomous species.

**Perichaena syncarpon** T. E. Brooks – Fig. 4

Tanzania: *Arusha*, SW of Oldonyo Sambu (cow) Lqt 6511-f.

The collection comprises scattered fructifications occurring together with *P. cf. liceoides* and *Licea alexopouli*. The pulvinate sporangia resemble specimens cited in the present paper as *P. corticalis*. However, the spores adhere in clusters (Fig. 4 B) as characteristic in *P. syncarpon*. The peridium appears to be scanty, having been observed only as short, simple or forked outgrowths from the inner peridium (Fig. 4 A). First record on dung.

**Calonema luteolum** Kow.

France: *Corsica: Bonifacio* (cow) Lqt 4425-q, 4427-f. *Porto-Vecchio* (cow) Lqt 4448-h – Spain: *Asturias, Cabo Peñas* (cow) Lqt 1908-g (GB) (1A as *Perichaena vermicularis*).

*Literature records:* Scotland: (sheep) Rammeloo 1978 – USA: (cow) Kowalski 1969 b.

So far this species is known only from dung. The specimens studied match perfectly (also in colour) the typical fruitings kindly sent by Kowalski for comparison. The species was previously known only from California and Scotland (Rammeloo 1978; a somewhat deviant collection).

**Arcyria cinerea** (Bull.) Pers.

Sweden: *Bl, Kristianopel* (horse) Lqt 3360-c (GB). *Gtl, Gotska Sandön Isl.* (hare) Tibell 2195-t (IMI, L). *Ög, Kisa* (horse) Lqt 3351-a. *Srm, St. Malm* (elk) Lqt 3344-c. *Upl, Älvkarleby* (capercaillie) Lqt 4604-e; Denmark (elk) Lqt 4216-f; *Läby* (cow) Lqt 4074-h; *Lena* (horse) Lqt 10530-a. *Vsm, Rytterne* (hare) Nordin 2932-y. *Gstr, Österfärnebo* (horse) Lqt 3488-f. *Hls, Mo* (horse) Lqt 2786-h. *Ång, Ytterlännäs* (horse) Lqt 3379-b – Norway: *Nord-Trøndelag, Hegra par., Einang* (horse) Lqt 3431-b (BPI, GB, PAD, PRM, TNS) – Canada: *Ontario, Rondeau Govt. Park* (deer) Cain 14.VIII.1938 (field coll.).

*Literature records:* Denmark: (dung) Hansen 1876 (as *Lachnobolus arcyrella*) – Finland: (dung) Karsten 1879 – Germany: (dung) Jahn 1916 – Spain: (cow, horse) Moreno & Barrasa 1977 – India (flying fox) Massee & Salmon 1902 (as *A. albida*) – Algeria: (horse) Durieu de Maisonneuve 1849; (camel, rabbit) Faurel & Schotter 1965 c, Faurel et al. 1966.

All material investigated by us is uniform and typical.

**Arcyria incarnata** (Pers.) Pers.

Sweden: *Hls, Söderhamn Archipelago, Enskär Isl.* (horse) Lqt 3199-b.

First record on dung.

**Arcyria** sp.

Sri Lanka: *Nuwara Eliya, Horton Plains, World's End* (black-naped hare) Moberg 2579-f.

Fructifications in small clusters, 1.5–1.8 mm tall, bright brick-red; stalks 0.2–0.3 mm long; sporangia subcylindrical, 0.3–0.4 mm wide, basal cups well defined; capillitial threads in upper part of the sporangium 2.0–2.5  $\mu$ m thick (excl. spines), densely spiny with short blunt spines (ornamentation reminiscent of that in *A. cinerea*); spores 8.0–8.5  $\mu$ m in diam., very faintly warted.

Apparently closely related to *A. cinerea*, and despite the colour and spore size perhaps possible to accommodate within this variable taxon.

**Stemonitis fusca** Roth – Fig. 2 B

Sweden: *Ög, Väversunda* (elk) Nordin 4234-d. *Boh, Säve* (roe deer) Nordin 4675-c. *Upl, Ärentuna* (hare) Lqt 5906-g, (roe deer) Lqt 5923-e (GB); *Bällinge* (elk) Lqt 9532-e; *Jumkil* (elk) Lqt 3821-e. *Vsm, Ångsö* (hare) Nordin 2983-k, (roe deer) Lqt 6258-d (slide); *Rytterne* (hare) Nordin 2932-x – Norway: *Finnmark, Berlevåg par., Mt Tuva* (blue hare) Lqt 5132-b.

*Literature record:* Tanzania: (dassie) Schmidt 1913.

The material studied is very uniform. The sporangia occur in small tufts, (3–)4–5(–6) mm tall (Fig. 2 B). With the exception of one aberrant collection (Lqt 3821-e) with probably premature sporangia, the spores have the characteristic ornamentation of *S. fusca* var. *fusca*.

**Stemonitis pallida** Wingate

Sweden: *Dlr, Garpenberg, Lake Pålshenningsjön* (elk) Lqt 8689-e.

Sporangia in small groups, c. 3 mm tall, dull brown; stalk c. one third of total height; columella tapering upwards, dissipating below apex; capillitial net appearing persistent also in upper part, bearing short spines, capillitial meshes 5–15  $\mu$ m; spores finely warted, 7–7.5  $\mu$ m in diam.

First record on dung.

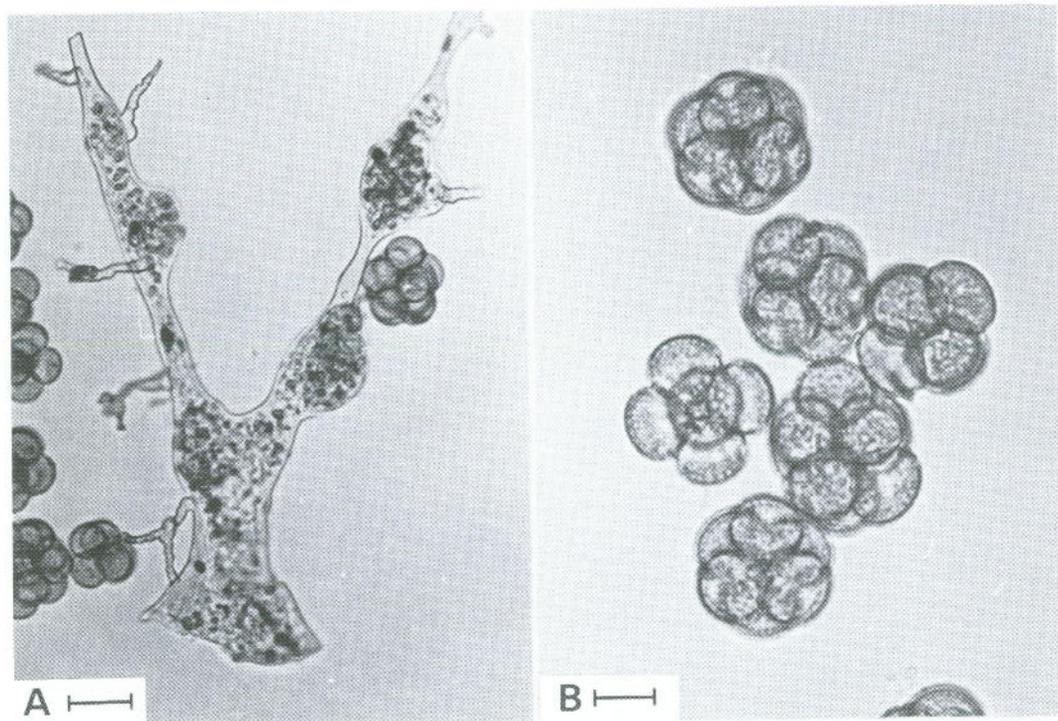


Fig. 4. *Perichaena syncarpon* (Lqt 6511-f). - A: Portion of peridium with capillitial outgrowths and spore clusters. - B: Spore clusters. - Scales: A 20  $\mu\text{m}$ , B 10  $\mu\text{m}$ .

***Macbrideola cornea*** (G. Lister & Cran) Alexop.  
- Fig. 5

Sweden: *Hrj*, Storsjö par., Mt Helagsfjället, 1400 m (lemming) K. & L. Holm 21.VIII.1967.

First record on dung. The collection comprises a few globose sporangia 0.1–0.2 mm in diam. (Fig. 5 A). The capillitium (Fig. 5 B) consists of robust strains, which originate at the tip of the columella, fork repeatedly, but remain almost even in width close to the periphery, where they end in short, diverging branchlets. The spores are 9.5–11  $\mu\text{m}$  in diam.

Except for spore size the collection fits the description of *M. cornea* given by Alexopoulos (1967). According to Alexopoulos the spores are 8.5–9.5  $\mu\text{m}$ , but Nannenga-Bremekamp (1971) has described a var. *macrospora* with spores 12–14  $\mu\text{m}$  in diam. The collection cited above bridges the gap between var. *cornea* and var. *macrospora* as far as spore size is concerned.

Lister (1925) noted that the stalk consists of a

“smooth thick-walled tube enclosing a central strand of parallel brown fibres”. The parallel “fibres” appear clearly in the columella (Fig. 5 B, C) in the collection cited above when seen in transmitted light. The fibres continue from the columella out into the capillitium. Peripheral parts of the capillitium contain two fibres (Fig. 5 D) or perhaps sometimes only one. Although it has not been possible to follow individual fibres further than between two or perhaps three ramification points of the capillitium, it seems as if the fibres themselves are not forked, but that each individual fibre is continuous from the peripheral part of the capillitium into the columella (and perhaps the stalk). However, this remains to be demonstrated. A sheath-like structure surrounds the fibre bundle and appears clearly in transmitted light in the columella and in the lower ramification points of the capillitium (Fig. 5 C). The stalk, columella, and capillitium in this species and also perhaps in related species merit ultrastructural studies.

**Leocarpus fragilis** (Dicks.) Rost.

Sweden: *Gstr*, Österfärnebo, Mattön Isl. (horse) Lqt 3488-e.

First record on dung.

**Badhamia apiculospora** (Härk.) U. Eliass. & Lundq., comb. nov.

Basionym: *Physarum apiculosporum* Härkönen 1978 p. 24.

*Badhamia semiannulata* Raub & Keller in Raub et al. 1979.

Sweden: *Sk*, Trollenäs (cow) Lqt 2395-b. (Santesson 1964 as *B. ovispora*, det. Lqt). *Öl*, Vickleby (sheep) Lqt 7285-e. *Upl*, Älykarleby (elk) Lqt 4602-f; Ärentuna (hare) Lqt 4823-f; Haga (hare) Gunnerbeck 1401-h, 1402-a, 1412-c (BR, GB) (EXS ined.). *Vsm*, Rytterne (hare) (with *Stemonitis fusca* Nordin 2932-x) - France: *Corsica*: *Calenzana* (cow) Lqt 4498-e; *Nonza* (rabbit) Lqt 4474-k - Poland: *Silesia*, Tamsel (roe deer) Vogel 13.III.1935 (field coll.?) - USSR: *Sibiria*, Irkutsk (goat) Olsson 15.VIII.1968 - Egypt: *Giza*, 40 km WNW of Cairo (goat) Lqt 5621-a (PAD as *B. ovispora*).

*Literature records* (as *B. ovispora*): Germany: (rabbit) Jahn 1916, 1919 - England: (dung) Jahn 1919 - Canada: (dung) Hagelstein 1944.

This species has generally been wrongly identified as *Badhamia ovispora* Racib. Keller et al. (1975) drew attention to the fact that Raciborski's original description was incomplete and inaccurate as regards the spore characteristics. The true *B. ovispora* is apparently a rare species, probably restricted to decaying wood or bark, while the coprophilous species commonly misidentified as *B. ovispora* was recently described (Raub et al. 1979) as *B. semiannulata*.

Härkönen (1978) described *Physarum apiculosporum* on material obtained on *Hordeum* seeds in a moist chamber culture. She noted that the spores were similar to those of *B. ovispora* sensu Martin & Alexopoulos (1969), but that the new material differed in having "clearly physaroid capillitium, dark spores and a single peridium".

After having studied a relatively large material (listed above) of *B. semiannulata* and compared it with isotype material of *P. apiculosporum*, we feel convinced that the two are conspecific. The shape, structure and colour of the spores agree perfectly in the two taxa and the spore type is unique among myxomycetes (Raub et al. 1979, Härkönen 1978). It is true that the capillitium in the type material of *P. apiculosporum* is physaroid but the capillitium of *B. semiannulata*

is rather variable and may often be physaroid, as noted by us as well as by Raub et al. (1979). The single peridium assigned to *P. apiculosporum* may be a doubtful character, since, in some of the material of *B. semiannulata*, poorly lime-encrusted specimens may appear as having a single wall-layer, and from cultivation of other *Badhamia* species it is known that the great variation in peridium structure may be due to external conditions. Finally, the two taxa seem to have similar ecological demands. *P. apiculosporum* was obtained on *Hordeum* and *Avena* in a moist chamber. *B. semiannulata* is often encountered in moist chamber cultures on straw and dung of herbivorous animals. Raub et al. (1979) reported abundant fruitings on hay mulch in greenhouses.

The specimens studied are referred to *Badhamia* because of the predominantly badhamioid capillitium. The inclusion of *P. apiculosporum* in *B. semiannulata* necessitates the new combination *B. apiculospora*. The delimitation of the genera *Physarum* and *Badhamia* is not altogether satisfactory and *B. apiculospora* is one of several species that make the borderline disputable.

**Fuligo cinerea** (Schw.) Morgan - Fig. 6

Spain: *Canary Islands*, Tenerife, San Andrés (rabbit) S 19304-m (with *Didymium dubium*).

*Literature record*: Martin & Rickett 1949.

This appears to be the minute distinct form of *F. cinerea* mentioned by Martin & Alexopoulos (1969) as sometimes developing in moist chambers. The plasmodiocarpous strands are convoluted or gyrose and closely massed (Fig. 6 A). The spores agree with those of *F. cinerea* in size and markings (Fig. 6 B, C).

**Physarum cf. bitectum** G. Lister

Norway: *Troms*, Tromsøysund par., Mt Fløjfjeldet (grouse) S 20108-c (GB).

*Literature record*: Hungary: (deer) Tóth 1965.

In the shape of the fructifications as well as in the size and ornamentation of the spores, this collection appears intermediate between *P. bitectum* and *P. bivalve* Pers. The plasmodiocarps are compressed, sometimes strongly so, generally curved, sometimes branched, in some cases annulate.

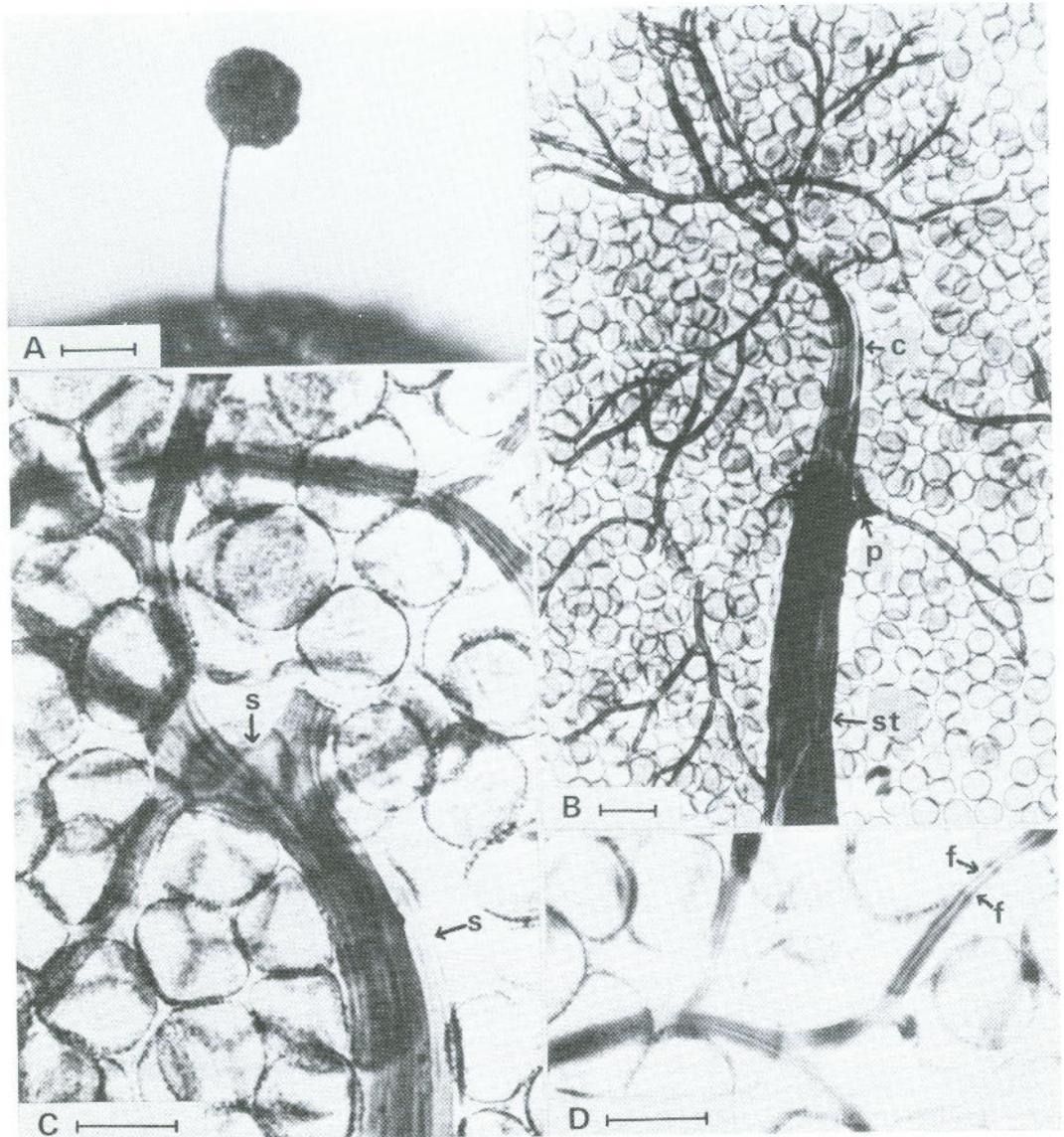


Fig. 5. *Macbrideola cornea*, specimen developed in moist chamber on dung from lemming (K. & L. Holm 21.VIII.1967). - A: Small-sized sporangium. - B: Crushed sporangium seen in transmitted light. The capillitium originates at the tip of the columella but some segments have loosened during mounting. c columella, p peridial collar, st stalk. - C: Upper part of columella with capillitium. The columella consists of a sheath (s) enclosing a central fibre bundle. The sheath is evident at several ramification points of the capillitium. - D: Peripheral part of capillitium. Single fibres (f) are distinct in transmitted light. - Scales: A 0.1 mm, B 20  $\mu$ m, C, D 10  $\mu$ m.

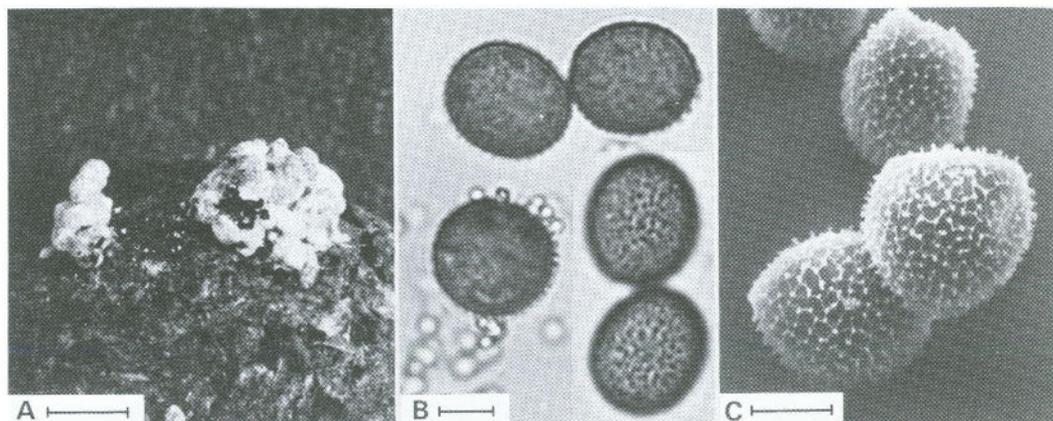


Fig. 6. *Fuligo cinerea*, a minute fimicolous form (S 19304-m). – A: Fructifications on rabbit dung, moist chamber culture. – B: Spores seen with the light microscope. – C: SEM picture of spores. – Scales: A 1 mm, B, C 5  $\mu$ m.

#### *Physarum confertum* Macbr.

Sweden: *Upl*, Vänge par., Fiby Forest (capercaillie) Lqt 1823-b (Santesson 1964).

#### *Physarum mucosum* Nann.-Brem.

Sweden: *Mpd*, Borgsjö, SW of Hallsta (horse) Lqt 2779-g.

This specimen has previously been cited as *P. mucosum* from Sweden (Santesson 1964). It is, however, very close to *P. contextum* (Pers.) Pers. The recognition of *P. mucosum* as a distinct species is questioned (cf. Eliasson & Strid 1976).

#### *Physarum nutans* Pers.

Sweden: *Bl*, Åryd (rabbit) Nordin 1280-i (Santesson 1964 as *Didymium iridis* det. Lqt). *Vg*, Magra (horse) Lqt 3131-g. *Upl*, Harbo (sheep) Lqt 9364-e.

First record on dung.

#### *Physarum* cf. *ovisporum* G. Lister

S Africa: *Cape Province*, Namaqualand, 30 km N of Kamieskroon at Buffelsrivier (donkey) Nordenstam 26.X.1962 (GB, N-B).

Sporangiate to plasmodiocarpous, fructifications scattered or aggregated in pairs or small groups; sporangia globose or subglobose, 0.4–0.5 mm wide, sessile on a constricted base; plasmodiocarps short, elongated or annulate;

hypothallus not evident; peridium single, slightly iridescent, densely white-flecked with lime; capillitium irregularly branched, the nodes small, rounded, elongated or irregular, sometimes tending to form a pseudocolumella; spore mass deep brown, shining; spores spherical, 11–12  $\mu$ m in diam. (excl. ornamentation), spinulose, brown in transmitted light, paler and less spiny on one side.

The specimen is tentatively referred to *P. ovisporum*, a species which – despite the specific epithet – may well have globose spores (Martin & Alexopoulos 1969). Farr (1976) included *P. ovisporum* in *P. vernum* Somm., thus giving a very wide circumscription to the latter. Certainly the collection cited comes within the limits of this wide variation range. *P. ovisporum* has not previously been recorded as fimicolous.

#### *Physarum pusillum* (Berk. & Curt.) G. Lister

Scotland: (rabbit) Martin 20.VIII.1964.

*Literature records*: Pakistan: (dung) Lodhi 1951 – Tchad: (goat, “goundi”) Faurel & Schotter 1966 – Congo: (“biche harnachée”) Faurel & Schotter 1965 d.

#### *Physarum* cf. *pusillum*

Egypt: *Giza*, 40 km WNW of Cairo (camel) Lqt 5620-h, (goat) Lqt 5621-b – USA: *California*, Los Angeles Co., Santa Catalina Isl. (cow) S 17297-e.

Sporangia 0.4–0.5 mm in diam., stalked; stalks 0.1–0.5 mm, brown, thickened and blackish at

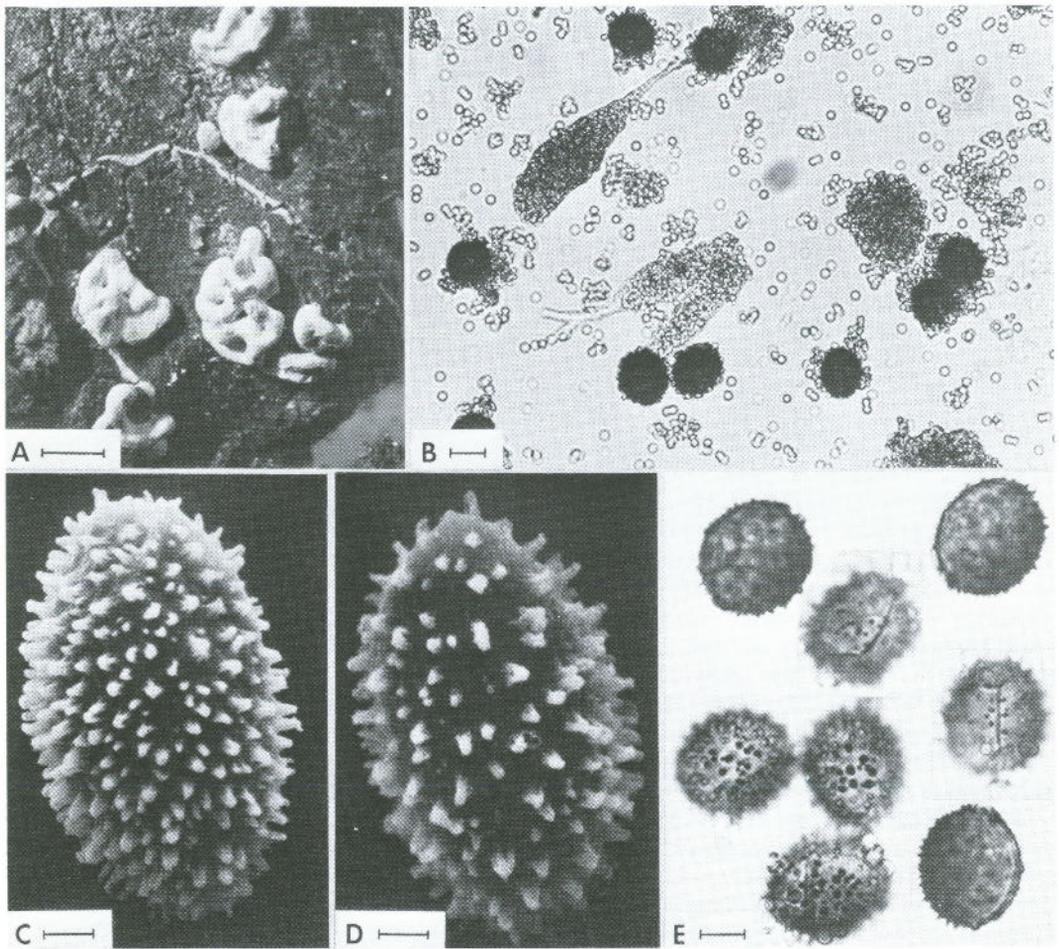


Fig. 7. *Physarum spinisporum* (Lqt 10617-b, holotype). – A: Fructifications on goat dung, moist chamber culture. – B: Capillitial nodes, spores and lime granules. – C, D: SEM pictures of spores. – E: Spores as seen with the light microscope. – Scales: A 1 mm, B 10  $\mu$ m, C, D 2  $\mu$ m, E 5  $\mu$ m.

base; spores dark brown in mass, pale brown in transmitted light, spinulose, 11–12  $\mu$ m in diam.

Deviant from typical specimens in spore markings and very short stalks (in S 17297-e not exceeding 0.1 mm). Yet it appears closer to *P. pusillum* than to any other species in the genus.

***Physarum spinisporum* U. Eliass. & Lundq., sp. nov. – Fig. 7**

Holotypus: Lundqvist 10617-b (UPS).

Spain: *Canary Islands*, Tenerife, the SE coast, Barranco del Río, at the motorway (rabbit) Lqt 9295-e, (goat) Lqt 10617-b – Ethiopia, *Harar*, Afdem, 1100 m (camel) Thulin 2507-k.

Plasmodiocarpi leviter appianati vel teretes–lateraliter compressi, plerumque 0.3–0.4 mm lati, curvati vel irregulariter ramosi et reticulati, tota fructificatione ad 2.5 mm extensa, saepe 1 mm vel minus; hypothallus non evidens; peridium subfuscum–albidum, bistratum, stratis arcte associatis, exteriore strato calce valide incrustato, interiore strato tenui, membranaceo; nodi capillitiales albi, elongati vel irregulares, nonnumquam ex parte badhamioides, parte centrali plasmodiocarpi saepe aggregati in pseudocolumellam; sporae in acervo nitide atrae, luce transmissa badiae, ambitu plerumque ovales, 12–14.5  $\times$  11–12  $\mu$ m (spinis omissis), spinae longitudine ad 1  $\mu$ m accedentes, sub microscopio luce instructo acutae apparentes, obtusae per microscopium electronicum inspectae, sporae pariete altera parte tenuiore et minus spinoso, hac parte (dumtaxat sporis in solutione KOH diluta inspectis)

crista longitudinali prominenti praedita, nonnumquam etiam cristis minus prominentibus (forsitan contractione effectis).

Plasmodiocarps (Fig. 7 A) curved or irregularly branched and netted, strands varying from slightly flattened or round in transection to laterally compressed, generally 0.3–0.4 mm wide, the whole fructification up to 2.5 mm in extent, often 1 mm or less; hypothallus not apparent; peridium dull greyish brown to white, 2-layered, but the layers closely associated, outer layer strongly encrusted with lime, inner layer thin, membranous; capillitial nodes white (Fig. 7 B), elongated or irregular, sometimes partly appearing badhamioid, tending to be aggregated into a pseudocolumella in the central part of the plasmodiocarpous strand; spores shining black in mass, reddish brown in transmitted light, preponderantly oval in outline (Fig. 7 B–E), 12–14.5 × 11–12  $\mu\text{m}$  (excluding spines), spines approaching 1  $\mu\text{m}$  in length (Fig. 7 C, D), appearing pointed in the light microscope, blunt when studied in scanning electron microscope, spore wall thinner and less spiny on one side, this side (at least when the spores are seen in a weak KOH solution) has a prominent longitudinal ridge (Fig. 7 E), sometimes also has less prominent ridges (shrinkage effects?).

*Physarum spinisporum* has some characters in common with *Badhamia apiculospora*, viz. the plasmodiocarpous fructifications and the predominantly oval spores with a longitudinal ridge. *P. spinisporum* differs in the prominent spines on the spores. Resemblances to the minute form of *Fuligo cinerea* (Fig. 6) also exist, but the spores of the latter lack a longitudinal ridge and the spines are shorter and interconnected by a network of low ridges (Fig. 6 C).

#### *Didymium anellus* Morgan

Spain: *Canary Islands*, Tenerife, the SE coast, Baranco del Río, at the motorway (rabbit) Lqt 8322-m.

First record on dung.

#### *Didymium clavus* (Alb. & Schw.) Rabenh.

Sweden: *Upl*, Börje (cow) Lundell, Stordal & Eriksson 12.VIII.1948 (field coll.); Lena (horse) Lqt 7217 (field coll.).

*Literature record*: Venezuela: (cow) Dennis 1960.

#### *Didymium difforme* (Pers.) S. F. Gray

Sweden: *Sk*, Ravlunda (rabbit) Nordin 2517-y. *Bl*, Jämshög (cow) Lqt 3369-f (EXS ined.) (GB). *Öl*, Bredsättra (cow) Lqt 2289-c. *Gtl*, Östergarn (rabbit) Lqt 2110-n; *Slite* (rabbit) Nordin 1226-h. *Ög*, Grebo (roe deer) Lqt 3350-h. *Srm*, Aspö (cow) Lqt 2022-k, 2023-k. *Upl*, Bälinge (cow) Lqt 2801-c (PAD); Dalby (hare) Lqt 2329-c; Jumkil (elk) Lqt 3821-f; Söderby-Karl (cow) Lqt 2515. *Vsm*, Ängsö (hare) Nordin 2983-e. *Ång*, Nätra (black grouse) Lqt 10257-d. *Hrj*, Tännäs, Mt Ramundberget (elk) Nordin 3352-g – Norway: *Finnmark*, Nord-Varanger par., Vestre Jakobselv (sheep) Lqt 5004-j – Finland: *Kuusamo*, Kuusamo par., Juuma (capercaillie) Lqt 11754-d. *Laponia inarenensis*, Utsjoki par., Utsjoki (grouse) Lqt 4925-f (GB) – Germany: Berlin (roe deer) Sydow VI.1887 (Sydow: Mycotheca Marchica No. 1497, 1887, as *Chondrioderma d.*) (UPS) – France: *Aveyron*, Chaos de Montpellier-le-Vieux (rabbit) Lqt 10164-n. *Bouches-du-Rhône*, les Baux (rabbit) Lqt 9688-f. *Corsica*: *Bonifacio* (cow) Lqt 4427-m – Tanzania: *Arusha*, Ngurdoto National Park, Lake Kusare (Cape hare) Lqt 6456-g – USA: *California*, Los Angeles Co., Santa Catalina Isl. (cow) S 17297-k (GB). *Colorado*, Boulder Co., Mt Steamboat (cow) S 18499-v (GB).

*Literature records*: Germany (dung) Jahn 1916 – Poland: (dung) Schmidt 1912 – Hungary: (cow, hare) Tóth 1965, 1967 – Algeria: (rabbit) Faurel et al. 1966 – Canada: (horse) Bisby et al. 1929 – USA: (cow) Keller & Anderson 1978.

#### *Didymium dubium* Rost.

Norway: *Finnmark*, Nord-Varanger par., Fossefjellet (blue hare) Lqt 4967 (field coll.) – France: *Bouches-du-Rhône*, les Baux (rabbit) Lqt 9688-g – Spain: *Canary Islands*, Tenerife, San Andrés (rabbit) S 19304-m (with *Fuligo cinerea*).

*Literature record*: Scotland: (bird) Dennis 1975.

#### *Didymium iridis* (Ditm.) Fries

Sweden: *Upl*, Vassunda, Ragnhildsvik (elk) Nordin 269-c (Santesson 1964).

*Literature records*: France: (manure) Cailleux 1973 (as *D. xanthopus*) – Algeria: (camel, goat) Faurel et al. 1966 – Tchad: (camel) Faurel et al. 1966 – Mauritania: (gazelle, goat, mule) Faurel et al. 1966.

The specimen is referred to this species because of the predominantly upright sporangia. The spores have conspicuous clusters of warts, which is reminiscent of *D. verrucosporum* Welden. In fact, in Farr (1976) the specimen would key to the last-named species. *D. iridis* and *D. verrucosporum* are closely allied, and the distinction between them is not altogether satisfactory.

**Didymium squamulosum** (Alb. & Schw.) Fries

Sweden: *Sk*, Jonstorp (rabbit) Junell 1664-r. *Bl*, Åryd (rabbit) Nordin 1868-v. *Öl*, Böda (hare) Lqt 3103-e. *Hl*, Fjärås (cow) Lqt 3120-b. *Srm*, Aspö (caterpillars on *Prunus spinosa*) Lqt 2473. *Upl*, Bälinge (cow) Lqt 2802 (GB); Jumkil (elk) Lqt 3821-d, (horse) Lqt 2340-g; Tensta (roe deer) Nordin 230-e; Uppsala (horse) Lqt 2322-b; Vassunda (elk) Nordin 269-e (PAD). *Vsm*, Kila (elk) Nordin 1477-b. *Hls*, Järvsö (horse) Lqt 2787-a – Sri Lanka: *Matale*, Dambulla (omnivore) Kers 8.IV.1973 – Canada: *Alberta*, Oldman River Watershed, Mt Pasque, 2450 m (moose) Tibell 4891-c.

*Literature records*: Germany: (dung) Jahn 1916 (as *D. effusum*) – Hungary: (cow, deer, hare) Tóth 1965, 1967 – Bulgaria: (cow) Khinkova & Ivanova 1965 – Algeria: (rabbit) Faurel & Schotter 1965 a – Canada: (horse) Bisby et al. 1929 – USA: (cow, rabbit) Angel & Wicklow 1975.

**Didymium trachysporum** G. Lister

Spain: *Mallorca*, Torrent de Pareis (sheep) Tibell 5861-d.

*Literature records*: England: (manure) Lister 1925 – Germany (deer, rabbit) Lister 1925 – Spain: (rabbit) Moreno & Barrasa 1977.

**Didymium verrucosporum** Welden

Tanzania: *Kilosa*, Ukaguru Mts, Mt Matandu (duiker) Thulin & Mhoro 2972-h.

First record on dung.

**Additional species reported from dung**

The records cited are unverified and their accuracy is sometimes questionable.

*Arcyodes incarnata* (Alb. & Schw.) O. F. Cook – Chile: (cow) Spegazzini 1921 (as *Lachnobolus incarnatum*).

*Arcyria elaterensis* Mull. – USA: (horse) Mulleavy 1977.

*Arcyria pomiformis* (Leers) Rost. – Canada: (cow) Wehmeyer 1950.

*Arcyria stipata* (Schw.) A. Lister – Norway: (reindeer) Moravec 1968 (as *Hemitrichia stipata* var. *fusca*). – The position in *Arcyria* is preliminary as we have not seen authentic material.

*Badhamia macrocarpa* (Ces.) Rost. – Morocco: (cow) Malençon & Bertault 1968.

*Colloderma oculatum* (Lippert) G. Lister – England: (rabbit) Harper & Webster 1964 – Tchad: (dassie, goat) Faurel & Schotter 1966.

*Comatricha mirabilis* R. K. Benj. & Poitras – USA: (goat) Benjamin & Poitras 1950.

*Comatricha nigra* (Pers.) Schroet. – Algeria: (Barbary sheep) Faurel & Schotter 1965 c – Tchad: (Barbary sheep) Faurel & Schotter 1966.

*Comatricha pulchella* (Bab.) Rost. – Algeria: (Barbary sheep) Faurel & Schotter 1966.

*Craterium leucocephalum* (Pers.) Ditm. – Algeria: (camel) Faurel & Schotter 1965 c – Canada: (horse) Bisby et al. 1929.

*Diderma ~~effusum~~ planatum* Fr. – Hungary (deer) Tóth 1965. *Diderma effusum* (Schw.) Morgan – Germany: (dung) Jahn 1916 – Hungary: (hare) Tóth 1965.

*Diderma globosum* Pers. – Hungary: (cow, deer) Tóth 1965.

*Diderma niveum* (Rost.) Macbr. – Argentina: (horse) Spegazzini 1912 (as *Chondrioderma niveum*).

*Diderma simplex* (Schroet.) G. Lister – Algeria: (Kabylian hare) Faurel & Schotter 1965 c – Tchad: (Barbary sheep, goat, sheep, camel, gazelle, "goundi") Faurel & Schotter 1966.

*Diderma testaceum* (Schrad.) Pers. – Hungary: (horse) Tóth 1965 – Canada: (porcupine) Wehmeyer 1950.

*Didymium melanospermum* (Pers.) Macbr. – Germany: (horse) Opiz 1816 (as *Physarum farinaceum*) – Hungary: (deer) Tóth 1965.

*Didymium nigripes* (Link) Fr. – Germany: (dung) Jahn 1916.

*Didymium quitense* (Pat.) Torrend – India (kangaroo, Delhi Zoo) Nannenga-Bremekamp et al. 1979.

*Didymium rugulosporum* Kow. – USA: (cow) Kowalski 1969 a.

*Didymium vaccinum* (Dur. & Mont.) Buchet – Germany: (rabbit, dung) Jahn 1916, 1919 (as *D. trochus*) – Hungary: (deer) Tóth 1965 – Canada: (cow) Bisby et al. 1929.

*Fuligo septica* (L.) Wigg. var. *rufa* (Pers.) R. E. Fr. – Yugoslavia: (dung) Schulzer von Muggenburg 1866 (as *Aethalium rufum*).

*Lepidoderma chailletii* Rost. – Hungary (cow) Tóth 1967.

*Licea* cf. *tenera* Jahn – Pakistan: (dung) Ahmed & Asad 1970 – USA: (sheep) Kowalski & Curtis 1968; (cow, pronghorn, rabbit) Angel & Wicklow 1975 – Brazil: (dung) Hagelstein 1944 – The records may refer to another species (see Kowalski & Curtis 1968 and the discussion under *Perichaena* cf. *liceoides*).

*Licea variabilis* Schrad. – Bulgaria: (horse) Khinkova & Ivanova 1965 (as *L. flexuosa*).

*Macbrideola coprophila* Nann.-Brem., Mukerji & Singh – India: (nilgai) Nannenga-Bremekamp et al. 1979.

*Oligonema schweinitzii* (Berk.) Martin – Germany: (dung) Jahn 1916 (as *O. nitens*).

*Perichaena pedata* (A. Lister) G. Lister – Germany: (rabbit) Jahn 1919.

*Physarum compressum* Alb. & Schw. – Algeria: (camel) Faurel et al. 1966 – Mauretania: (goat) Faurel et al. 1966 – Tchad: (camel, gazelle, goat, Barbary sheep, sheep, donkey, dassie, Kabylian hare, "goundi", bird of prey, rock dove) Faurel & Schotter 1966 – Congo: ("biche harnachée", gazelle, roan antelope) Faurel & Schotter 1965 d – Gabon: (buffalo, goat, sheep) Faurel & Schotter 1965 d.

*Physarum contextum* (Pers.) Pers. – Germany: (dung) Jahn 1916.

*Physarum didermoides* (Pers.) Rost. – Germany: (dung) Jahn 1916 – Hungary: (cow, horse, hare) Tóth 1965, 1967 – Algeria: (camel, goat, dassie, "sand rat") Faurel & Schotter 1965 b, c.

*Physarum fimetarium* Schum. – Denmark: (cow)

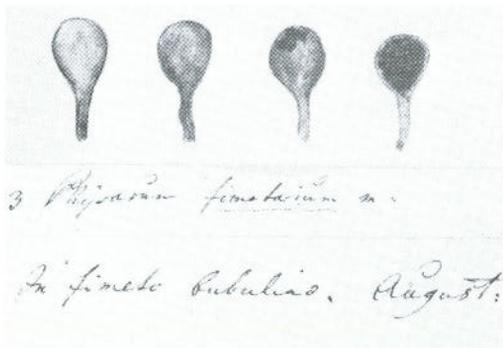


Fig. 8. Photograph of the illustration of *Physarum fimetarium* in Schumacher's unpublished *Flora hafniensis fungi delineati*, Vol. I, p. 71 (herbarium C).

Schumacher 1803 – Belgium: (rabbit) Marchal 1895 – Germany: (cow) Wallroth 1833.

The figures of *P. fimetarium* in Schumacher's *Flora hafniensis fungi delineati* (Vol. 1, p. 71), an unpublished work in three volumes (at C) with descriptions and hand-painted illustrations of some of the fungi described in his flora of 1803, show four yellowish-brown, stipitate fruit-bodies at various stages of development, but no microscopic details (Fig. 8). The published diagnosis runs as follows:

“Sparsum, primo fluxile album deinde subalutaceum pyriforme substipitatum, demum peridio obovato vertice lacero dilute purpurascens-umbrino; capillitio compacto pulvereque fusco, stipe breve subflexuoso superne paululo incrassato colore peridii. In fimeto bubulino. August. veget.”

The paintings are accompanied by a hand-written, partly illegible description that deviates somewhat from the published one (Schumacher 1803 p. 205). We find, however, that the descriptions and illustrations are of no help for the identification of this fungus, neither to species, nor to genus. Since type material is also lacking (Dr H. Knudsen, Copenhagen (C) in litt.), we reject *P. fimetarium* as a nomen dubium.

*Physarum leucopus* Link – Algeria: (camel) Faurel & Schotter 1965 b, c.

*Physarum nucleatum* Rex – Algeria: (“goundi”) Faurel & Schotter 1965 c.

*Squamuloderma nullifilium* Kow. – USA: (cow) Kowalski 1973.

*Trichia contorta* (Ditm.) Rost. – Germany: (dung) Jahn 1916.

*Trichia fimicola* (March.) Ing – Belgium: (rabbit) Marchal 1895 (as *T. varia* var. *fimicola*). – Scotland: (rabbit) Ing 1967.

The following species have been reported without indication of country or kind of dung. Only species not listed above are included.

Martin & Rickett 1949: *Arcyria leiocarpa* (Cooke) Martin & Alex. (as *Hemiarcyria leiocarpa*), *Didymium ochroideum* G. Lister, *Echinostellium minutum* de Bary, *Lamproderma scintillans* (Berk. & Br.) Morgan, *Perichaena minor* (G. Lister) Hagelst.

Hertel 1962: *Cribraria violacea* Rex, *Physarum cinereum* Schum., *Trichia varia* (Pers.) Pers.

Keller 1971: *Perichaena vermicularis* (Schw.) Rost.

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